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SPECIFIC NAMES OF THE ATLANTIC AMERICAN WHITE SHRIMP (FAMILY PENAEIDAE)

by

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Introduction

Penaeid shrimp are of special interest to zoologists for several reasons, one being the fact that they are unique among the decapod Crustacea in having a nauplius larval stage, which is otherwise found only in lower groups.

The shrimp catch of the south Atlantic and Gulf coasts in 1960 amounted to one-fifth of the total value of all fishery products of the United States (Power, 1961), and the shrimp fishery is the most valuable one in the country. The catch depends almost wholly upon three species, *Penaeus aztecus* Ives, *P. duorarum* Burkenroad and *P. setiferus* (Linnaeus), according to current usage. Up to about fifteen years ago the whole fishery depended upon the latter species, the North American white shrimp.

Because of their commercial importance, the penaeid shrimp are being studied increasingly in the Americas and other parts of the world. The literature, museum records and certain other information show that the name *Penaeus setiferus* has been misapplied for the past twenty-six years. The matter should be rectified now rather than later. The questions involved depend upon established rules of zoological nomenclature.

The following account will be easily understood if it is remembered that there are two species of Atlantic American white shrimp. This fact was ascertained by Burkenroad (1936) and prior to that time all workers assumed that there was only one species, which was referred to uniformly as *Penaeus setiferus* (Linnaeus). The northern species has been recorded only from the continent of North America. The southern species has been recorded throughout much of the West Indies and the east coasts of Middle and South America to southern Brazil.

Names of White Shrimp in the Literature

Early Work, 1761 - 1811

Guillaume Rondelet is reported by some early workers to have figured penaeid shrimp, but Linnaeus made no reference to his works.

Seba (1761) figured a penaeid shrimp to which he gave the name, *"Astacus fluviatilis, Americanus."* This magnificent work was published in three volumes between 1734 and 1761. Seba's names are not binominal and are considered to be pre-Linnaean, even though volume three is later than the tenth edition of the *Systema Naturae.* But Seba's shrimp figure is important because Linnaeus referred to it when he set up the species *Cancer setiferus* (*Systema Naturae,* 12th ed., 1767). I examined the figure in the Library of Congress copy of Seba (Vol. III, Plate 17, Figure 2).

It is evidently a penaeid and the only question is whether or not it could be one of the so-called grooved shrimp (those with long adrostral carinae, *P. aztecus, P. duorarum* or *P. brasiliensis*). However, some of the early workers saw the less noticeable dorsal sulcus on the telson of these shrimp and possibly the long rostral grooves would have been noticed, too. The walking legs all appear to be bifid, but not clearly chelate, as Say (1817) says all six of them were portrayed. Linnaeus' remarks may also be interpreted as "six double clawed feet on both sides". In spite of these doubtful points, Seba's figure has been accepted as the original one of *Penaeus setiferus* because it was so designated by Linnaeus.

With regard to the distribution of *Cancer setiferus,* Linnaeus (1767, p. 1055) stated *"Habitat in Indiis".* Since Seba's use of the *Americanus* in the name was the only locality reference he gave, it appears that Linnaeus was referring to the West and not the East Indies, and that assumption has been commonly accepted.

The next reference to *Cancer setiferus* is in the thirteenth (Gmelin) edition of *Systema Naturae* (1790). The habitat is given as *"America australi et India".* Because of that statement Burkenroad (1939, p 18) says, "It is not impossible that the Linnaean imputation of American habitat to *C. setiferus* was derived from Seba, and that the type was a specimen from the East Indies which somewhat resembled Seba's plate; . . . . .". Due to the way it is worded, this remark of Burkenroad's is not questionable, but it is more likely that between the time of the twelfth and thirteenth editions of the *Systema* some East Indian shrimp were added to the Linnaean collections, which Gmelin and his co-workers could not differentiate from the American *C. setiferus.* It is even more probable that Gmelin did not add the qualifying West to India, a common failing of early writers. Earlier workers sometimes referred to this insular group as the West India Islands, and it is only in the past eighty years or so that this usage has gone out of style. Be that as it may, subsequently the name was employed exclusively for Atlantic American material.

The next reference is that of Herbst (1796), who said, "Es lebt dieser Krebs in den Amerikanischen Flüssen, ..." He gave a figure (Table 34, Figure 3), and gave the names of Seba and Linnaeus as synonyms for his name, *Cancer (Gammerellus) setiferus.* Olivier (1811), gave all of the above names as synonyms and used the name *Palaemon setiferus.* He said, p. 660, "Il se trouve dans les fleuves de l'Amerique méridionale."

Thus, there are five works referring to the geographic distribution of the shrimp, later called *Penaeus setiferus,* published between 1761 and 1811. They are summarized as follows:

Seba (1761)	*Astacus fluviatilis*	America
Linnaeus (1767)	*Cancer setiferus*	Indies
Gmelin (Linnaeus) (1790)	*Cancer setiferus*	South America and India
Herbst (1796)	*Cancer (Gammerellus) setiferus*	America
Olivier (1811)	*Palaemon setiferus*	South America

At the time Seba wrote the Dutch had no holdings in North America, but they did have holdings in South America, and it is more likely that Seba's specimens came from there than from the north. Linnaeus' subsequent use of "Indiis" for the habitat reinforces that assumption. The four Linnaean and post-Linnaean works refer to the Indies and South America three times as the locale of the shrimp later known as *Penaeus setiferus* (Linnaeus), and to "America" once. There was no reference to North America and no indication that penaeid shrimp existed in North America, and that was the situation when Say (1817) wrote.

The Name of the North American White Shrimp

Say gave a valid description of the North American white shrimp as *Penaeus fluviatilis,* and made the first mention of the species in the literature, this being also the first mention of a penaeid shrimp in North America. He designated a definite locale for the species, the coasts of the southern states of the United States and Florida (which was then a Spanish possession). No other species of shrimp with short adrostral carinae has ever been recorded from the eastern shore of continental North America. Say's designation is easily the most precise in the shrimp literature up to his time and there is no reasonable way by which it can be questioned or set aside.

Say referred to no previous author except Seba, whose name is invalid. Therefore, Say's name, *P. fluviatilis,* is first under the Rules. Whether Say avoided other previous works on purpose or through lack of knowledge is unknown. However, he followed Seba's name, which he did not think was a good one because the shrimp was not an inhabitant of rivers, although he stated that it was found in the mouths of rivers "probably as high as salt water extends." His color notes show that he was acquainted with the animal in life. He said that great numbers were caught in the estuaries by cast-nets and brought to market, sometimes as far north as Philadelphia.

In extenuation of the early workers who gave the rivers as habitats of white shrimp, it should be noted that differences between rivers and low salinity estuaries were not clear then, and even today there is sometimes confusion. It should be noted that Olivier (1811) used the word "fleuves", which refers to rivers emptying into the sea, as differentiated from the inland "rivières".

Say's name was used in synonymy by Hay (1918), Boone (1930) and Burkenroad (1934 and 1939); it has not lapsed under the "fifty year rule".

Gibbes (1850) said specimens were present in the "Philadelphia cabinet", but apparently none remain today. Mr. F. H. Aldrich was kind enough to search Academy of Natural Sciences of Philadelphia collections for Say's *Penaeus* material, but none could be located. I have deposited in the U. S. National Museum six specimens of *Penaeus fluviatilis* Say which were caught by the Fish and Wildlife Service MV *Silver Bay* at station 3178 off Brunswick, Georgia. They consist of three males, 163, 149 and 152 mm. long and three females, 173, 175 and 181 mm. long, and are catalogued under the U. S. National Museum number 107160. Six females from the same *Silver Bay* station, ranging in length from 162 to 175 mm., have been deposited in the collection of the Academy of Natural

Sciences of Philadelphia. The collections were made through the courtesy of Mr. Harvey R. Bullis, of the Fish and Wildlife Service, Pascagoula, Mississippi, to whom I am indebted.

Burkenroad (1939) gave the distribution of this species from "critical records", as Fire Island, New York to Vera Cruz, Mexico, Cuba and Jamaica. Considerably more has been learned about distribution since then. There seems to be three discrete populations centered off the Georgia coast, the Louisiana coast, and the southern Gulf of Campeche, Mexico. There is no evidence that this shrimp ever has been found away from the shores of the North American continent, and Burkenroad's inclusion of Jamaica and Cuba within the range is incorrect. Burkenroad (1939, p. 17) has designated a neotype of this species under the name *P. setiferus*. It is fortunate that for various reasons, his designation has not been validated, since his action did not take all facts into consideration.

In summary, Say (1817) gave the first description and made the first mention of a North American white shrimp and all previous accounts relate to the Indies of South America or indefinitely, America. The valid name of the North American white shrimp is *Penaeus fluviatilis* Say.

Later Work, 1837 - 1939, *and the Name of the South American White Shrimp*

No works following Say (1817) have bearing upon the validity of his name, *P. fluviatilis,* (except that by using it as a synonym they preserved it), but they explain why the confusion of shrimp names was not cleared up by the several eminent zoologists who worked on penaeids later.

First, it should be repeated that no one realized that two species of shrimp were involved until Burkenroad (1936) described the West Indian, Central and South American species as *Penaeus schmitti.* (For locality records see Burkenroad, 1936 and 1939, pp. 19-20). The names of the two shrimp with short rostral grooves should have been applied properly at that time, but it was not done and the question was not considered until three years later (Burkenroad, 1939). His remarks were curiously misleading, and they led to the incorrect conclusion that the proper name of the South American white shrimp is *Penaeus schmitti.*

H. Milne Edwards (1837), who used the name *Penaeus setiferus,* synonymized the names of Seba, Linnaeus, Herbst, Olivier and Say, cited above, with his own specimens from the French island of Guadeloupe, and stated (p. 415) that the species is found in considerable numbers around the mouths of the rivers of Florida. Later workers followed this lead. Heller (1865) reported *Penaeus setiferus* from "Rio Janeiro", and as Burkenroad (1939, p. 18) said, "Following Heller, the range of *P. setiferus* has been universally considered to be from the United States to Brazil, until the recent separation of *P. schmitti.*"

He states that H. Milne Edwards (1837), DeKay (1844), Gibbes (1850) and Heller (1865) all used *Penaeus setiferus* for the white shrimp, which is quite correct. However, DeKay and Gibbes were referring only to North American shrimp, which is *P. fluviatilis* as we have seen. Heller's single specimen came from Rio de Janeiro and Milne Edwards' specimen

or specimens were not North American by any long stretch of the imagination. Burkenroad's remarks are, p. 18, "H. Milne Edwards, 1837, synonymizes *P. fluviatilis* with the Linnean species and presumably derives from Say the statement that *Penaeus setiferus* inhabits the mouths of the rivers of Florida [since according to Bate, 1881, the surviving Edwardsian specimen is labelled "Guadaloupe" (a most indefinite provenance perhaps referring to San Antonio Bay, Texas, at the mouth of the Guadaloupe River)]." That peculiar interpretation is clearly incorrect. The French island of Guadeloupe in the West Indies is a most definite provenance and lies within the range of the southern white shrimp. (Bate probably misspelled it.) French naturalists and collectors have worked in that area since the days of Father Charles Plumier and it is almost certain that Milne Edwards' specimens derived from there. Rio Guadalupe of Texas has a Spanish spelling and in 1837, and before, it was inhabited by no one except a very primitive tribe of Indians, the Carancahuas, and a few traveling Spanish (and later Mexican) soldiers, who were certainly not recognized collectors of natural history specimens. That Bate (1881) looked upon Milne Edwards' material as West Indian is shown by the following remarks concerning certain material in the Jardin des Plantes, listed as *P. indicus* (p. 178), " . . . . ; but these bear the impress of having been named by others than the veteran author of 'Histoire des Crustacés!' they agree more nearly with *Penaeus setiferus* of the West Indies, ..." H. Milne Edwards equated his species with the then well known North American species because all naturalists assumed at that time that one species extended over both North and South America. But as stated above, none of the writing or synonyms following Say (1817) has any bearing upon the name of the North American species.

Linnaeus (1767), Gmelin (1790), Olivier (1811), Milne Edwards (1837) and Heller (1865) all applied *Penaeus setiferus* to shrimp from the Indies or South America. Burkenroad's remarks that de Saussure (1858) first applied the name to shrimp from definite localities outside the United States is misleading. It is incorrect with regard to H. Milne Edwards, and although the earlier workers did not give small, specific localities, they gave general ranges all within the known area of the South American white shrimp. Furthermore, de Saussure's paper was no hallmark or turning point in taxonomy and Burkenroad's statement in this regard carries no authority. In fact, de Saussure's Cuban specimens were almost certainly the southern white shrimp. Peréz-Farfante (1954) has shown that the southern white shrimp (listed as *P. schmitti*) is present in commercial quantities in Cuba, but the northern species has never been taken there. A letter from her dated 31 May 1961 confirms that conclusion.

Burkenroad (1939, p. 19) also said, "Despite doubt as to the precise nature of the Linnean types, usage would seem to make desirable retention of the name *Penaeus setiferus* for one of the Atlantic American species with short adrostral carinae. Inasmuch as definite records of *'Penaeus setiferus'* from areas outside of the present known range of the northern species did not appear in the literature until relatively very late, it has seemed proper to restrict the Linnean name to the northern species." No one can disagree with the first sentence, but the last one is definitely erroneous. Linnaeus (1767), Gmelin (1790) and Olivier (1811) referred only to the range of the southern white shrimp. Other references, which refer to definite records of the southern white shrimp as *Penaeus setiferus*

are H. Milne Edwards (1837), de Saussure, *auct.* (1858), Heller (1865), Bate (1881), and Rathbun (1897 and 1900). The localities are Guadeloupe, Cuba, Rio de Janeiro, Jamaica and Maceio, Brazil. Beginning with Linnaeus, this makes an average of one reference to the southern species as *Penaeus setiferus* every fifteen years between 1767 and 1900. The last six records are by workers who caught the shrimp or examined museum specimens, and do not include citation records which I have made no attempt to enumerate. During the same period the only similar reference to the northern species as *Penaeus setiferus* are DeKay (1884), Gibbes (1850), Stimpson (1871) and Kingsley (1879).

Say (1817) validly named the North American white shrimp *Penaeus fluviatilis* and there is no point upon which his designation can be set aside. On the other hand, the long taxonomic tradition of the specific name *setiferus* for the South American white shrimp, extending back to Linnaeus, cannot be capriciously overthrown. Thus, there is no gainsaying the fact that the correct name of the West Indian and South American white shrimp is *Penaeus setiferus* (Linnaeus), and *P. schmitti* Burkenroad is a synonym. The types of Linnaeus have been lost, and according to Bate only one of Milne Edwards' specimens remained in 1881. Heller's specimen is probably gone with World War II. Burkenroad's types of *P. schmitti* could stand as neotypes of *Penaeus setiferus* (Linnaeus). However, according to the 1961 Code, neotypes are not needed for either of the Atlantic American white shrimp, and probably they could not be validated for various reasons.

There remains the rather inconsequential question of *Penaeus orbignyanus* of P. A. Latreille (1817), which H. Milne Edwards said was not differentiable from *P. setiferus.* Latreille's shrimp was reputed to have come from the Bay of Biscay, a highly doubtful locality, and the type has been lost, as Burkenroad has shown. It throws no light upon any question and seems best relegated to the status of a *nomen dubium.*

Almost every member of the Division of Marine Invertebrates of the U. S. National Museum helped me at one time or another in obtaining literature, and I am indebted to them. I am also indebted to Drs. F. A. Chace, Jr., and Frederick M. Bayer for discussing taxonomic points with me.

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On the Names of *Penaeus setiferus* (L.) and *Penaeus schmitti* Burkenroad

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ON THE NAMES OF *PENAEUS SETIFERUS* (L.) AND *PENAEUS SCHMITTI* BURKENROAD

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Dr. Gordon Gunter, who sent me the manuscript of his paper "Specific Names of the Atlantic American White Shrimp (Family Penaeidae)" for comment was so kind to allow me to have my reactions to it published simultaneously with it. Unfortunately I cannot agree with Doctor Gunter's views on the scientific names that should be used for the two Atlantic species of White Shrimp.

In the first place I believe that Doctor Gunter's suggestion that the northern species should be known at *Penaeus fluviatilis* Say and the southern as *P. setiferus* (L.) instead of respectively *P. setiferus* (L.) and *P. schmitti* Burkenroad, is not in accordance with the International Code of Zoological Nomenclature.

Second I believe it against the interest of stability and uniformity of nomenclature to switch a well-known name from one economically important species to another, as this will inevitably lead to serious confusion, and will especially cause difficulties to non-taxonomists.

In explaining my first point it is necessary to look into the question of the identity of the species which Linnaeus (1767, Syst. Nat. (ed.12)1: 1054, 1055) described as *Cancer setiferus*. Linnaeus' description runs as follows: "setiferus. 78. C[ancer]. manibus nullis, pedibus utrinque sex didactylis, antennis longissimis.

*Seb.mus.*3. *t* 17.*f.*2.

Habitat in Indiis.

Manus ingrassatae nullae. Antennae corpore duplo longiores."

The fact that Linnaeus described six pairs of didactyl legs shows that he had no actual material before him, as all Penaeids have only three pairs of chelate legs. Linnaeus must therefore have based himself exclusively on Seba's figure of *"Astacus fluviatilis, Americanus"*, in which indeed all five legs plus the third maxilliped are shown as being didactyl. This figure thus is erroneous in ascribing a didactyl ending to the third maxilliped and to the last two pairs of legs. As Linnaeus' description is exclusively based on Seba's figure, we must consider Seba's specimen to be the holotype of *Cancer setiferus* L. For those authors who think it possible that Linnaeus did have additional type material, I now select the specimen figured by Seba (1761, Locuplet. Rer. not. Thes. 3: pl. 17 fig. 2) to be the lectotype of *Cancer setiferus* Linnaeus, 1767; by this action the question of the type specimen of Linnaeus' species is settled. The figure of Seba's *Astacus fluviatilis, Americanus* shows a large Penaeus with short rostral grooves and as such it has been considered by all authors. The fact that all the legs and the third maxilliped are shown to be didactyl is clearly a slip of the artist. It is impossible from

the figure alone to fix the identity of the species. The locality from where the specimen originates might help to narrow down the number of species to which it could be assigned. Linnaeus (1767) gave as the locality *"Habitat in Indiis"*, which evidently is an error as Seba himself reported the species from America. The type locality must therefore be considered to be "America", though not too much importance can be attached to this locality indication, as Seba's animals were often incorrectly labelled. However, the figure shows nothing which would make it impossible for Seba's specimen to be one of the American species of the group of *Penaeus* with short rostral grooves and therefore the locality indication should be considered to be correct. Gunter's argument that Seba's specimen most likely belongs to the southern species as at "the time Seba wrote the Dutch had no holdings in North America, but they did have holdings in South America" does not hold very well, as in Seba's time (1687-1736) Amsterdam was an important port which received ships from all over the world and not only from the Dutch possessions. Engel (1937, Svenska Linné-Sällskapets Årsskrift 20: 80-81) described "how Seba hastened on board the newly arrived ships and selling and distributing medicines among the often exhausted and sick crew, it was an easy thing for him to get from them at very small prices the curiosities they had brought from the Indies, from Africa, America etc.". Furthermore Seba had correspondents in many different countries, who sent him material. So Engel (1937:81) mentioned Seba's connections in Virginia. There is no reason therefore making it impossible for the type specimen of *Cancer setiferus* to have come from the area inhabited by the Northern White Shrimp.

Until 1936 all authors have given the name *setiferus* to what they thought to be the only East American species of *Penaeus* with short rostral grooves. When in 1936 Burkenroad (Annaes Acad. Brasil. Sci. 7(4):315-318) discovered that not one but two species of the *setiferus* group inhabit the Western Atlantic, he had to decide which form should be given the name *setiferus*. Since the information available about the type specimen of *Penaeus setiferus* (L.) (being only Seba's figure, his worthless description, and the locality indication "America") is not sufficient to show its identity with either the Northern or the Southern White Shrimp, Burkenroad as first reviser (i.e., as first zoologist to distinguish between the two species) was perfectly justified to restrict the name *setiferus* to the species he thought best. Personally I believe it a very wise action of Burkenroad to leave the name *setiferus* to the best known of the two species and to give a new name to the rarer species. In 1936 no restriction of the type locality of *Cancer setiferus* L. had been published, no neotype had been selected for the species and no additional information about the type specimen had been brought forward. Not even Burkenroad (1936) did make any of these restricting actions officially, though he clearly intended to restrict the name *setiferus* to the northern species. The first valid action by which the name *setiferus* L. was definitely restricted and linked to one of the two species was Burkenroad's (1939, Bull. Bingham Oceanogr. Coll. 6(6):17) neotype selection for *Cancer setiferus* L. This neotype selection is perfectly valid and fulfills all requirements for neotypes set by Article 75 of the International Code of Zoological Nomenclature. The neotype of *Cancer setiferus* L., 1767, is a male specimen of the northern species from off Matanzas Inlet, Florida (8 - 10 fathoms, otter-trawl, April 2, 1934, M. B. Bishop); it is now preserved under Reg. No. B.O.C.237 in the collection of the Bingham Oceanographic Collection of Yale University, New Haven,

Connecticut, U.S.A. The specific name *setiferus* L., 1767, thus is the oldest available name for the northern species, the name *fluviatilis* Say, 1817, falling as a junior synonym. The locality off Matanzas Inlet, Florida, thus becomes the restricted type locality for the species. This locality falls within the original type locality "America". If Linnaeus' (1767) locality indication "*in* Indiis" is not considered an error for "America" but a restriction of the type locality meaning either both the East and West Indies or only the West Indies (which in my opinion would be far fetched), then still Burkenroad's type locality restriction to Florida is valid, as the term West Indies formerly was generally employed not only for the Antillean Islands but also for a large part of the American mainland. So in the (1914-1917) Dutch "Encyclopaedie van Nederlansch West-Indië" (:742) it says that "for many years after the discovery of the new world the name West Indies was used for the continent of America as well as for the group of islands situated between 10° and 28° N" (translation by the present author). Until this day in Dutch the word "West Indië" is used to indicate both the Netherlands Antilles and Suriname. Also in A. Vazquez de Espinosa's "Compendium and Description of the West Indies" (1942, Smithson, misc. Coll. 102) Florida is one of the first areas to be dealt with (:106). Therefore I cannot find any valid argument to contest the correctness of Burkenroad's (1939) action to restrict the specific name *setiferus* to the Northern White Shrimp.

My second point concerns the question whether or not it is in the interest of nomenclatural stability and uniformity to have the name *P. setiferus* restricted to the northern species. As shown by Gunter, in the literature both the northern and the southern species were rather sporadically dealt with in taxonomic, and practically not at all in non-taxonomic papers. However, in the course of the 19th century the northern species became the subject of important fisheries, especially in the South Atlantic and Gulf States of the United States. According to Johnson & Lindner (1934, Invest. Rep. U. S. Bur. Fish. 21:3, 4) the annual catch of shrimp in that area fluctuated between 7 and 20 million pounds in the period between 1889 and 1908, but soon rose to become around 100 million pounds a year between 1927 and 1931; it was 150 million pounds in 1943 (cf. Fishery Resources of the United States, 1945, 79th Congress 1st session, Senate Doc. 51:91). Of this catch 95% consisted of *Penaeus setiferus* (L.). Around 1934, the economic importance of the southern species was negligible, being only of some local interest in Brazil (cf. Johnson & Lindner, 1934:68). Therefore practically all the non-taxonomic and most of the taxonomic literature dealing with *"Penaeus setiferus"* before 1936, actually treated the northern species. When Burkenroad in 1936 discovered the specific distinctness of the northern and southern species, his action to leave the name *setiferus* with the northern species was, from a viewpoint of nomenclatural stability and uniformity, a very laudable one. In this way the name *setiferus* was kept for the well known economically very important species about which there existed an extensive literature in which it was always indicated under the name *P. setiferus,* while the new name *P. schmitti* was given to the poorly known southern species, which at that time had hardly any economic importance and about which there was hardly any literature. In recent years the interest in shrimp fisheries in Latin America is greatly increasing and with better fishing facilities it has become possible there to fish more intensively and also to fish in formerly unexploited areas. In the fishery literature on the Southern

White Shrimp, which is rapidly building up, the species is consistently indicated with the name *Penaeus schmitti.* Summarizing, we can say that before the discovery in 1936 of the fact that there are two species of East American White Shrimp, practically all non-taxonomic and the greater part of the taxonomic literature concerned the northern form, which (like the southern) was uniformly indicated as *Penaeus setiferus.* When the literature on the southern form increased due to the increasing economic importance of the species, the name *P. schmitti* had already been introduced for it and at present the species is indicated in all literature with that name.

Concluding I may remark that the well-established current use of the name *Penaeus setiferus* (L.) for the Northern White Shrimp and that of *Penaeus schmitti* Burkenroad for the Southern White Shrimp, according to the International Code of Zoological Nomenclature is the legal nomenclature for these species. Any change in these names therefore would not only upset the uniformity and stability of the nomenclature of these two species, but would at the same time be contrary to a strict application of the Code.

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Reply to Dr. L.B. Holthuis on the Names of White Shrimp

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REPLY TO DR. L. B. HOLTHUIS ON THE NAMES OF WHITE SHRIMP

by

Gordon Gunter

(As an explanation to the reader it should be stated that my paper was submitted to Doctor Holthuis for Crustaceana. He asked me to withdraw it and I did so saying that I would publish it elsewhere. He then asked me to publish his remarks along with it, to which I agreed, and they are given above. However, his interpretations and ideas in this instance are contrary to the International Code of Zoological Nomenclature. Therefore, I have prepared the following rebuttal.)

Doctor Holthuis' remarks can be answered in the same way that they are stated, in generalities and in specific detail. His expressed devotion to nomenclatural stability is no less than my own and we differ only in the approach to the attainment of stability. In fact, Doctor Holthuis' aims would be better served if he would apply the Rules regarding generic names of penaeid shrimp (Gunter, 1957) and not set up *Penaeus,* erroneously, as the root word for all genera (Holthuis, 1959).

We are now only in the second hundred years since the establishment of zoological taxonomy and yet many zoologists, including taxonomists, are impatient to have stability of nomenclature attained within their lifetime, which is clearly impossible if for no other reason than the fact that there are too few specialists, and many groups go for years without being worked on. Zoologists will do well to have things fairly stable within the third century of formal systematics.

In Doctor Holthuis' remarks there is the implication that things have stood as they are for many, many years and thus should not now be disturbed. This is incorrect. When I started work on shrimp thirty-two years ago, there were only two species of *Penaeus* recognized on the whole eastern coast of the Western Hemisphere. Today, five species are recognized and there has been a vast overturn in usage, due to the works of Burkenroad, some of which lead to dismay among the older carcinologists. The case in question here is only twenty-six years old, and it stems from the time Burkenroad described the South American white shrimp as new. The period is short in terms of zoological nomenclature.

Doctor Holthuis has stated that Burkenroad's designation of the Matanzas, Florida specimen as the neotype of the *Penaeus setiferus* is valid. Yet he wishes to establish Seba's figure as the lectotype. This is unnecessary, if not contradictory. If the neotype is valid, a lectotype is not needed. Additionally, his lectotype designation is invalid for three reasons. First, it is contrary to the "Recommendation" that lectotype selection shall have as its object the definition of the species. The two species in question are well defined, and Seba's figure will not help "define" the species. Such a lectotype would not serve his purpose anyway since he cannot show it derived from North America. It is invalid for the same reason. As I have shown above and additionally below, the documented evidence indicates that Seba's specimen was South American.

Doctor Holthuis' learned discussion of Seba's figure is correct of course, but it is not pertinent to the case, except to indicate that the figure would be a singularly unfortunate lectotype for the purpose of "clarifying" the species. The Code clearly states that a zoologist designating a lectotype should publish "at least" the data listed under Recommendation 73C, listed under 10 categories, only 8 of which apply to a non-fossil marine species. Doctor Holthuis can supply none of these except that the specimen was, presumably, adult. For this reason, too, his lectotype is very poor and probably is invalid. It would be best to let that matter lie and retain Linnaeus' name by common assent, as has been done.

Seba's figure has been accepted as the original of *Cancer setiferus* by general accord of earlier workers and the same general accord indicates that it was South American. There is little to be gained now by designating this figure, known to be erroneous in some ways, as the lectotype. In fact, Doctor Holthuis' aim is to set up a northern locality for this lectotype, and that cannot be done without going in the face of all evidence.

Doctor Holthuis' inclusion of lower Florida in the Indies involves an idea so old that it has been forgotten. But even so, his argument is invalid due to the known distribution of the white shrimp. These do not exist in the Keys nor on the West Florida coast along the shores of the peninsula. They are present only in very small and scattered concentrations as far south as the St. Lucie inlet, on the east coast, where I have taken them in recent years (Gunter, 1959). This is south of the previously known southernmost Florida records at Cape Canaveral, which is north of 28° N., the northern Florida limit for the Indies. It should be pointed out that Matanzas Inlet is in north Florida, within 50 miles of the Georgia line, much farther north of 28° N. It is hardly possible that Seba obtained white shrimp from the southern part of Florida, because the area does not lie within the range of either species.

In suggesting that Seba's specimen may have come from some other part of the South Atlantic coast of the present United States, Doctor Holthuis has overlooked a matter of American history. The American Colonies were required to trade with the mother country, and mostly, if not altogether, in ships of British registry. Such ships did not generally travel from the American Colonies to the Dutch ports. These trade restrictions were the basis for one of the complaints that led to the American Revolution a few years later. Except for very rare strays, white shrimp do not extend north of Cape Hatteras, North Carolina, and Seba's Virginia connections would hardly have yielded him any white shrimp. The Virginia, New Jersey and New York records of white shrimp are comparable to the rare examples of tropical marine fishes sometimes reported from southern Canadian waters. The whole idea of North American origin of Seba's specimen is far-fetched and highly improbable.

The Rules, or Code as they are now called, were devised to bring about order and justice in the naming of species by biologists and their application must be determined on these grounds. If it were left to laymen, the whole system of Latin specific names would probably be abolished. Therefore, I am making no attempt to answer Doctor Holthuis' remarks on that score because their bearing on the question is indirect at best.

Doctor Holthuis has avoided completely the question of the rights of Thomas Say in this matter and the related one concerning what obligations later workers have to him in this connection.

Burkenroad's designation of the neotype of *Penaeus setiferus* is invalid for four reasons. The neotype was not selected to resolve a complex zoological circumstance. The distinction of the two species of American white shrimp has never been questioned. The differences are clear and their distribution is disjunctive. No zoological questions are involved, only taxonomic ones. The neotype is further invalid because there is considerable positive evidence, and none to the contrary, that it is outside of the range of the species traditionally referred to as *Penaeus setiferus*. Furthermore, the only "exceptional circumstance" was Burkenroad's somewhat lame defense of *Penaeus setiferus* as the name of the North American white shrimp after erroneously giving the South American species a new name, which error he recognized apparently sometime between 1936 and 1939 (see literature cited above). Therefore he did not designate the neotype at the time he "revised" the species, which must be done, according to the Code. The Code indicates clearly that neotypes are not necessary for either one of the two species under discussion and would be quite difficult, if not impossible, to validate before the Commission. This would do grave injustice to Thomas Say.

Gmelin (1790), Olivier (1811), H. Milne Edwards (1837), de Saussure, *auct.* (1858), Heller (1865), Bate (1881), and Rathbun (1897 and 1900) all used *setiferus* as the specific name for the South American white shrimp. If we were to doubt all earlier writers and their clear designations of South America for other species of organisms, taxonomy would be thrown into a terrible state of confusion. The statements of the workers on the name and distribution of *P. setiferus* are positive evidence, and there is no positive evidence to the contrary. Doctor Holthuis refers pejoratively to the few older records of white shrimp as sporadic, but the fact that there have been few workers with the Crustacea does not justify

ignoring the work that was done. When Rathbun (1896) gave a new name to the common blue crab of the western Atlantic she cited all previous scientific literature and came up with only four previous references.

The men closest to Linnaeus in time, and who possibly had information which we do not know about, referred to the South American white shrimp as *setiferus,* and these are the only positive references in the literature.

The older workers knew how to write and say North America, but nobody had ever mentioned a North American white shrimp (or a penaeid) until Thomas Say described the species, and his description and name is valid. Attempts to avoid this simple and straightforward conclusion serve no good purpose taxonomically or otherwise. Such usage is in the interest of correct and stable zoological nomenclature. According to the Code, the proper name of the South American white shrimp is *Penaeus setiferus* (Linnaeus) and the proper name of the North American white shrimp is *Penaeus fluviatilis* Say.

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Studies on the Larval Development of *Rithropanopeus harrisii* (Gould) of the Family Xanthidae (Brachyura)

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STUDIES ON THE LARVAL DEVELOPMENT OF *RITHROPANOPEUS HARRISII* (GOULD) OF THE FAMILY XANTHIDAE (BRACHYURA)

by

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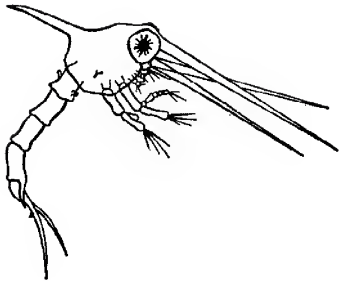
INTRODUCTION

Because the early biologists did not see decapod larvae "in the act" of changing from one phase to another due to the fact that they were parts of planktonic collections and their parentage was unknown, each phase was given a generic and specific name of its own. Gurney (1924) did not concur with this practice, but was of the opinion that it is more profitable to assign larvae to definite genera or families, even if the reference proved to be wrong.

The chief difficulty encountered in rearing decapod larvae is the maintenance of a constant supply of suitable living food (Needham, 1959). The early embryonic studies of brachyuran crustaceans did not reveal complete life histories. This was due primarily to the lack of effective culture techniques. Birge (1883) gave no details of his culture methods in the study of the development of *Panopeus sayi* (Smith). Hyman (1925) gave no account of an attempt to culture larvae of xanthid crabs. In recent years the use of definite diets for the larvae has resulted in a knowledge of complete life histories. Knudsen (1959) used *Artemia* nauplii in feeding larvae of four xanthid crabs of the California coast. Chamberlain (1961) used various combinations of *Artemia* nauplii and two species of algae to feed larvae of three xanthid crabs of the North Carolina coast. His best results were with a diet of *Artemia* alone.

Former studies of brachyuran embryology at the Gulf Coast Research Laboratory were confined to the description of larvae taken in planktonic collections at or near the surface. Advanced larval forms are not found in such collections. It seldom happens that in planktonic material a series of stages of the same larvae is taken which is sufficiently complete to enable the genus to be determined. The remainder must be identified as nearly as possible by reference to published descriptions of larvae whose parentage is known, and such identification must in many cases be very speculative.

Hyman (1925) described a prezoeal, four zoeal and a megalops stage of *Neopanope texana sayi* (Smith) at Beaufort, North Carolina. Also in his studies is a description of a prezoeal and the first zoeal stage of *Eurypanopeus depressus* (Smith). Knudsen (1958, 1959, 1960) described culture methods and four zoeal stages and a megalops stage of four species of xanthid crabs from California. Prezoeae were described for two of these species. Chamberlain (1961) described culture methods and four zoeal stages and a megalops of *Neopanope texana sayi* (Smith) at Duke University Marine Laboratory, Beaufort, North Carolina.



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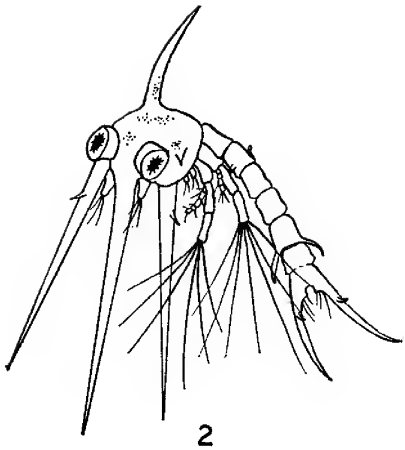

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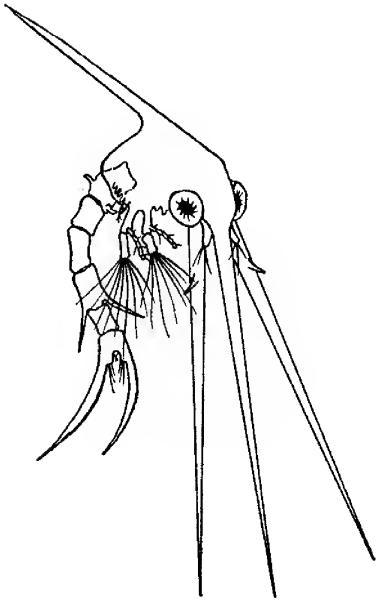

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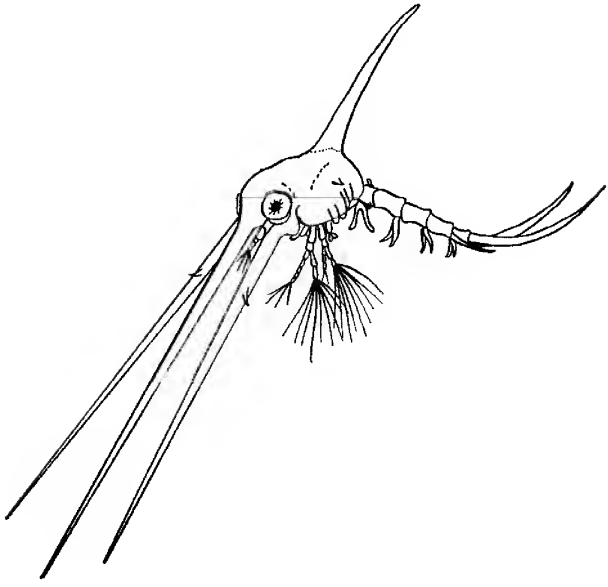

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PLATE I

Figure 1
First Zoea

Figure 2
Second Zoea

Figure 3
Third Zoea

Figure 4
Fourth Zoea

This is a report of a study of the embryonic development of crabs of the family Xanthidae from Biloxi Bay. The larvae were hatched and reared in the laboratory. The work was supported by a Summer Research Grant from the National Science Foundation to the Gulf Coast Research Laboratory.

Acknowledgements are given to Dr. Gordon Gunter who arranged for the grant and made the facilities of the Laboratory available. C. E. Dawson identified the adult crabs. Dr. Harry Bennett assisted in making measurements.

METHODS

In the present study culture methods used successfully by Knudsen (1958) and Chamberlain (1961) were employed and larvae taken from the plankton were used only to support observations of those reared in the laboratory.

Ovigerous females of *Rithropanopeus harrisii* (Gould) were collected from the estuarine water (salinity, 10.83 0/00 + 0.2 0/00) near the laboratory. They were found in oyster shells and other inaccessible places and were abundant from June 15 through August 12. These females were taken to the laboratory immediately and placed in shallow bowls containing water from the bay to await the incubation of their eggs. The more concave valve of an oyster shell was placed in the water under which the crab would retreat.

Immediately after hatching approximately thirty of the most active larvae were placed in each of two Petri dishes containing water from the bay. Once each day those remaining alive were removed with a pipette to a Petri dish of fresh bay water and were fed newly hatched *Artemia* nauplii. The dishes were kept in a closed cabinet to keep dust from settling on the surface of the water and to prevent the absorption of various fumes present in the laboratory. Aeration of water in the dishes was not necessary since the ratio of water volume to surface area allowed ample exchange of gases. The air temperature of the cabinet remained at 27° + 2° C.

Between each use of the Petri dishes they were washed with a detergent powder and sterilized in a steam sterilizer.

Measurements were made by use of an ocular micrometer.

Larvae from individual cultures representing each stage were preserved in 5% formalin in sea water for morphological study.

OBSERVATIONS

Ovigerous females of *Rithropanopeus harrisii* (Gould) were abundant from June 15 through August 12 with eggs at different stages of development. Newly deposited eggs were dark purple-brown, changing to lemon-yellow just before hatching. The length of the incubation period was not determined since it was not known when the eggs were deposited. The longest period between the collection of a female with eggs and the hatching of her eggs was twelve days (July 24 to August 5).

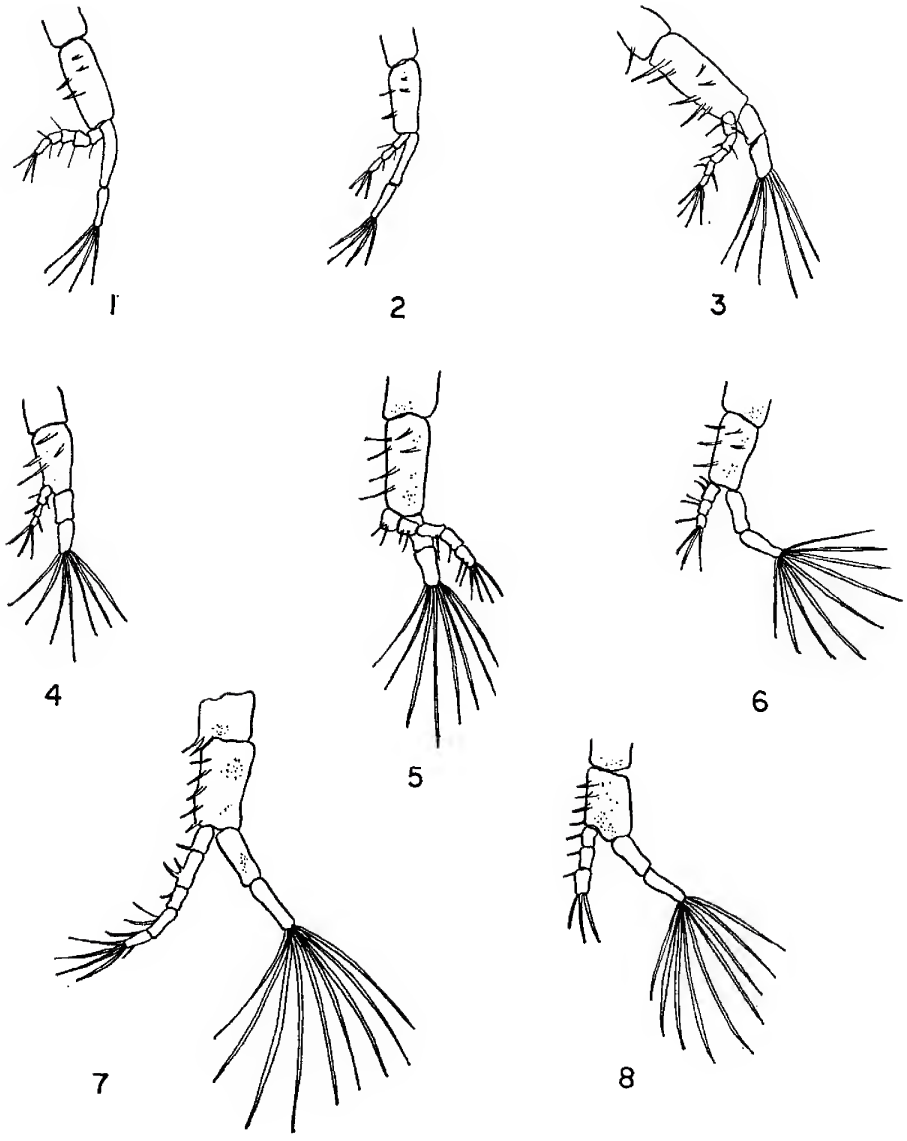

PLATE II

Figure 1
First Maxilliped of
First Zoea

Figure 2
Second Maxilliped of
First Zoea

Figure 3
First Maxilliped of
Second Zoea

Figure 4
Second Maxilliped of
Second Zoea

Figure 5
First Maxilliped of
Third Zoea

Figure 6
Second Maxilliped of
Third Zoea

Figure 7
First Maxilliped of
Fourth Zoea

Figure 8
Second Maxilliped of
Fourth Zoea

Fungus infection was not noticed. A protozoan, *Zoothamnion* sp., or a related organism, was commonly attached to the egg masses and to the zoeae. This added more weight to the spine-burdened body of the larvae and interfered with their ability to capture the nauplii and most of them died without molting.

Several zoeae were observed in the process of molting. One had trouble getting the antennal spine out from the old shell. One pulled forward from the fissure on the dorsal surface of the carapace leaving the dorsal spine, for a time, parallel to the shell from which it came. This gave the appearance of two dorsal spines.

Accurate records were not kept on the duration of each larval stage. It was generally observed that more time was spent between the first and second zoeal stages and between the fourth zoeal and the megalops stages than the intermediate ones. One culture went from the first zoeal to the megalops in fifteen days. Newly hatched larvae of a related species, *Eurypanopeus depressus* (Smith), were only slightly larger than the *Artemia* nauplii and were not seen eating them. This probably accounts for their lack of development through the successive stages. The zoeae of *Rithropanopeus harrisii* (Gould) were larger and eagerly devoured the nauplii soon after young ones were fed to them.

DESCRIPTION OF LARVAE OF *Rithropanopeus harrisii* (Gould)

The zoeae of *Rithropanopeus harrisii* (Gould) are the most striking of the several species of xanthid crabs of Biloxi Bay due to the elongated rostral and antennal spines. These appendages give the animal a very awkward appearance, yet it is quite active and a good swimmer.

FIRST ZOEA
(Plate I, Figure 1)

Carapace—The rostral spine is an extension of the anterior end of the carapace between the unstalked, compound eyes. It is about 930 microns long, which is only slightly less than the combined lengths of the cephalothorax and the abdomen. It begins as a relatively stout process and gradually tapers to a sharp point. It is entirely smooth, having no setae as is found in many xanthid larvae. The size and weight of this spine, together with the two antennal spines which are almost as long, make the anterior end of the animal proportionately heavier than the remainder of the body and account for its awkwardness and cause it to swim backward. The dorsal spine projects backward from near the posterior margin of the carapace. It is about 300 microns long and has a slight posterior hook at the tip. It extends upward and backward approximately parallel to a line from rostral spine. There is a short lateral spine extending from each side of the carapace. These are more easily observed when looking at the animal from a dorsal view.

Appendages—The antennule is short and unsegmented with a tuft of three or four long hairs at the distal end. The spinous antenna is about 775 microns long. It is entirely smooth with the exception of the *anlage* of a flagellum located near the proximal end. In a front view the two

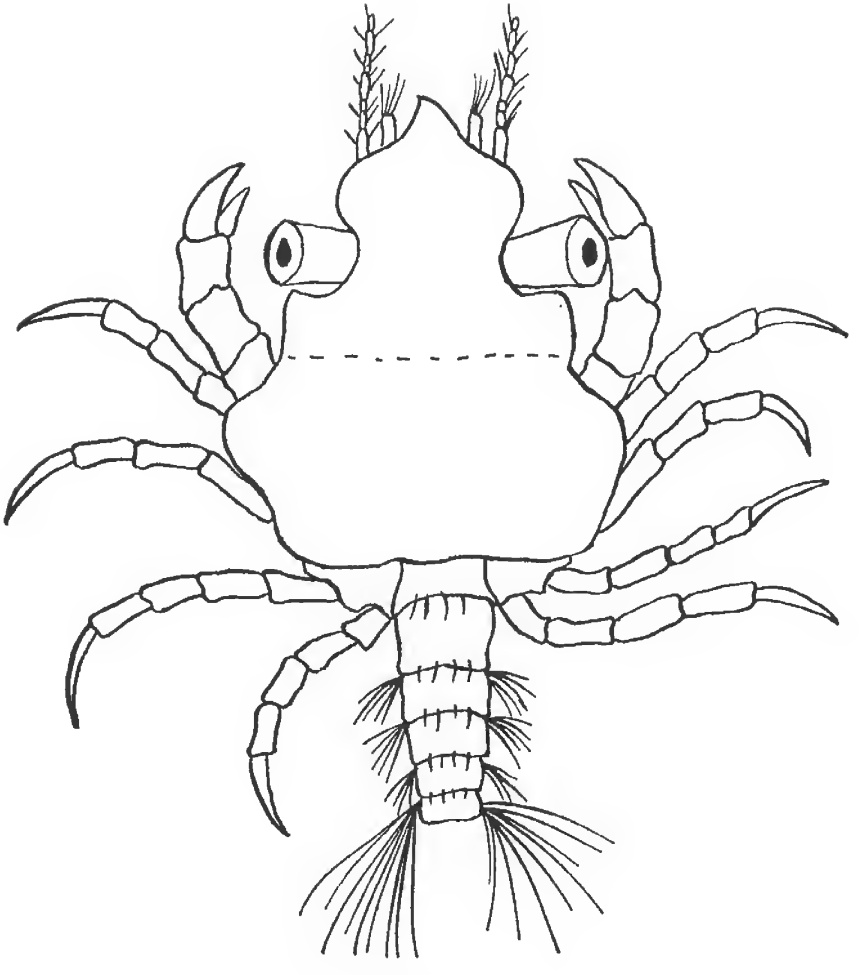

PLATE III

Megalops

antennae and the rostral spines project from the head almost parallel with one another. In preserved specimens the antennal spines diverge out at lateral angles. The mandible is scarcely discernible but the two pairs of maxillae can be seen under the ventral margin of the carapace. The first maxilliped (Plate II, Figure 1) is composed of a five-segmented endopodite with three terminal swimming hairs. There are short setae between each segment. There is a two-segmented exopodite with four long swimming hairs at the distal end. The second maxilliped (Plate II, Figure 2) is like the first except that the endopodite is smaller and has only three segments. The remaining appendages have not developed sufficiently to be evident.

Abdomen—there are five segments—the sixth being indiscernibly fused with the telson. There is a blunt process on the postero-ventral margin of the second segment. The fifth segment extends into a pair of long postero-lateral spines. The cornua of the telson are slender and greatly elongated (418 microns long) with a dorsal hook at the tip of each. There is a short dorsal and three barbed median spines on each cornu.

SECOND ZOEA

(Plate I, Figure 2)

Carapace—The rostral spine has increased in length to about 1985 microns and remains smooth to the tip. The dorsal spine has become slightly arched and is about 500 microns long. The lateral spines remain the same as in the first zoea. Pigmentation of the cephalothorax under the carapace has darkened from an orange color to a brownish-orange.

Appendages—The eyes have become stalked. The antennule is still unsegmented and retains its tuft of three or four distal hairs. The antennal spine is now 930 microns long. The other features remain unchanged from the first zoeal stage. The mandible and the two maxillae remain as they were in the former stage. There are now six swimming hairs on the exopodite of the first maxilliped (Plate II, Figure 3) and seven on that of the second (Plate II, Figure 4). *Anlagen* of the third maxillipeds and the pereiopods can be seen.

Abdomen—A line separating the sixth segment from the telson has become slightly visible. The cornua of the telson are now about 465 microns long and the dorsal spine of each has become more evident.

THIRD ZOEA

(Plate I, Figure 3)

Carapace—The rostral spine is now about 1500 microns long and remains smooth to the tip. The dorsal spine is 775 microns in length. Other features of the carapace have had a proportionate increase in size.

Appendages—The antennule is slightly larger. The antennal spines are now about 1394 microns in length. The exopodite of the first maxilliped (Plate II, Figure 5) has eight swimming hairs and that of the second (Plate II, Figure 6) has nine. The third maxilliped now shows as a three-segmented exopodite with several setae. The first pereiopod shows a chela. The other four periods are well started and *anlagen* of the pleopods are present.

Abdomen—The telson is now distinctly divided from the sixth segment. The ventro-lateral spines of the fifth segment are about 175 microns long or twice the length of the segment. The cornua of the telson are 542 microns in length. A fourth pair of median spines has appeared between the cornua.

FOURTH ZOEA

(Plate I, Figure 4)

Carapace—The rostral spine is now 1643 microns long and remains smooth to the tip. The dorsal spine is 666 microns long. The lateral spines remain unchanged throughout the series.

Appendages—The antennule has become more conical and is segmented. The number of distal hairs has increased. The antennal spine is 1472 microns in length. The *anlage* of the flagellum located near the proximal end of the antenna has become a very evident spike. There are nine swimming hairs on the terminal segment of the exopodite of both the first and second maxillipeds (Plate II, Figures 7 and 8). Other features of these two appendages and those of the third maxilliped remain unchanged from the third zoea. The pereiopods are well developed and the pleopods have become biramous.

Abdomen—The blunt processes of the second segment described in the first zoeal stage have persisted throughout the series and have become horn-like in the fourth stage. The abdomen has added no new characters. The cornua of the telson are now 600 microns long.

MEGALOPS

(Plate III)

Only three zoeae molted into the megalops. Two of these remained in the fourth and last zoeal stage three days each. The other remained as a fourth zoeal larva for five days. This extended time of the latter must have been due to infestation with the protozoan, *Zoothamnion sp.* referred to in Observations. The thoracic appendages of this megalops were deformed—being extended posteriorly. The two normal specimens were retained for further development. They are awkward and move slowly but feed well on the *Artemia* nauplii.

Carapace—The long rostral spine has been reduced to a short, ventrally bent projection between the stalked eyes. The lateral and dorsal spines are absent. The carapace is about 800 microns wide.

Appendages—They were not studied in detail.

Abdomen—The six-segmented abdomen is carried folded under the cephalothorax. It is 800 microns long.

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